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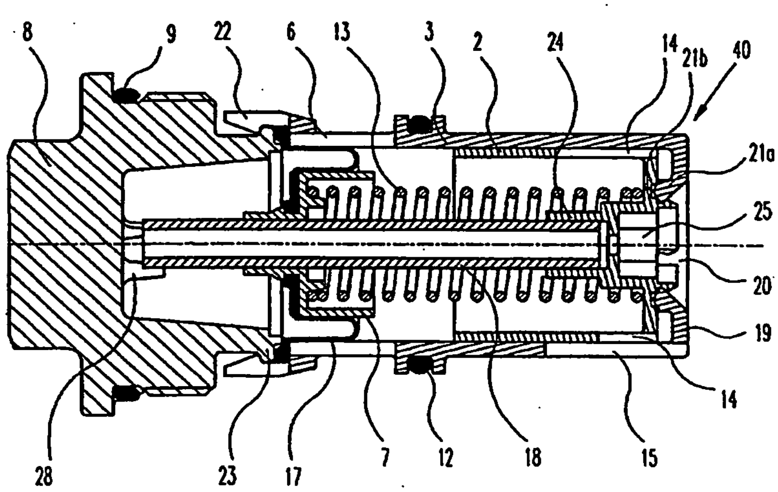

(57) Abstract

a throttle valve comprises a piston element (2) and a sleeve (3), which encloses and can be turned around the piston element (2). Each element (2, 3) is provided with a number n of holes and is adapted to be turned individually to create the restriction area (14, 15), the number n of holes (14) in one element (2) being equal to the number of covering areas (15) in the second element (3). The valve can be used for automatic regulation of a central heating or air-conditioning system so that the flow is limited to a predetermined amount in the entire system, in one part hereof or in several parts hereof being divided into zones, when both elements (2, 3) are divided in equally large segments, when there is a maximum of one hole in each segment, when the area of the holes in one element (2) is larger than the area (A_n) of the largest hole in the second element, and when the equidistant division is determined by the number n of holes according to the formula $2^n - Dx2$, where D is the number of equally large segments along the circumference and where there are two turning positions for each segment D.

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STOP OR SLIDE VALVE, ESPECIALLY FOR THE CONTROL OF LIQUID FLOW IN A CENTRAL HEATING OR AIRCONDITIONING PLANT.

The invention relates to a throttle valve, especially for the control of liquid flow in a central heating or air-conditioning system consisting of two concentric elements, for example two circular plates disposed in close contact with each other, or two cylindrical sleeves, one of which is inside the other, said elements having a number n of holes and being adapted to turn individually to create a restriction area with a permanent open position, which is optional among several open positions having different areas, and being located equidistantly along the circumference of the elements, the number n of holes in one element being equal to the number of covering areas in the second element.

The systems may, for example, be circulation systems, wherein the liquid medium after heating can emit heat, or after cooling can absorb heat from the surroundings.

These systems are normally referred to as heating systems respectively cooling systems (air-conditioning), in which the different rooms are provided with valves to regulate the heating or the cooling of the room. If the valves in one or more rooms are used, the pressure in the entire system will change. It is, therefore, desirable to have a self-regulating valve inserted into the system.

DE Patent Specification no. 32 23 206 describes a valve of the above mentioned type, which is provided with at least two radial grooves, each having its own feed channel, and a valve arrangement for providing connection as desired between a feed channel and the opening of the valve. In this construction it is possible by means of the valve arrangement to adjust different amounts of flow in a

system having a liquid medium when the radial grooves have varying cross sections.

These amounts of liquid are to a great extent independent from the differences in pressure within the system, which is the reason why this known valve is not self-regulating when changes of pressure occur within the system.

It is therefore an object of the present invention to provide such design of the known valve that the valve can be used as an automatic regulator for regulation of the flow of liquid in a system having a liquid medium to the effect that the flow is limited to a predetermined amount in the entire system, in one section thereof or in more sections, divided into zones.

This object is achieved by means of a valve of the above described type, which valve according to the invention is advantageous in that both elements are divided into segments of equal size, that each segment has a maximum of one hole, that the area of the holes in one element is larger than the area of the largest hole in the second element, and that the equidistant division is determined by the number n of holes according to the formula:

$$2^n = Dx2,$$

wherein D is the number of equally large segments along the circumference, and where there are two turning positions for each segment D.

The dependent claims refer to advantageous embodiments of the valve according to the invention.

The throttle valve according to the invention will be explained in detail in the description below with reference

to the accompanying drawing, wherein:

Fig. 1 is a horizontal plan drawing of a first and a second plate, which are adapted to be turned with respect to one another about a shared axis,

Fig. 2 is a table showing the turning positions of the two plates illustrated in Fig. 1,

Fig. 3 illustrates an axial section through a valve according to the invention in a first embodiment of an insert having a first restriction area for selection of a permanent open position, and a second restriction area having a piston, which is movable in dependence of the difference in pressure in a system having a liquid medium,

Fig. 4 illustrates the section IV-IV indicated in Fig. 3,

Fig. 5 illustrates the section V-V indicated in Fig. 3,

Fig. 6 illustrates an inside sleeve or piston of the valve in Fig. 3, as seen in axial section, in a side view and in a plan view from the closed end,

Fig. 7 illustrates an outside sleeve in the valve of Fig. 3, seen in axial section,

Fig. 8 illustrates the section VIII-VIII indicated in Fig. 7,

Fig. 9 illustrates the section IX-IX indicated in Fig. 7,

Fig. 10 illustrates an axial section through a valve according to the invention in a second embodiment of an insert having a first restriction area, in which a permanent open position can be selected, and a second restriction area having a membrane, which is movable in dependence of the difference in pressure in a system having a liquid medium,

Fig. 11 is a drawing of the insert illustrated in Fig. 10 seen from one end, and

Fig. 12 is a diagram illustrating the amount of liquid flow at different selective permanent open positions having varying cross sections.

A throttle valve according to the invention will be explained first with reference to Fig. 1, which illustrates two concentric plates, which are adapted to turn about a shared axis after having been positioned in level against one another. The plates are divided into four equally large segments D along their circumference, each being 90°. When turning the plates about the shared axis, two turning positions are anticipated for each segment D.

In the first plate three of the segments D are provided with an opening A_1, A_2, A_3, said openings extending over an angle of 45°. The three openings have different areas, the areas being defined by circular arcs having the same inside radius but with different outside radii. It will be seen that there is at least part of a segment D between two openings.

In the second plate, three of the segments D are provided with recesses, two of which extend at an angle of 45°, whereas the third recess extends over 90°. The recesses are

inwardly defined by an inside radius, which is smaller than or equal to the above mentioned inside radius of the first plate. Outwardly, the recesses are defined by outside radii, which are equal to or larger than the largest outside radius of the openings in the first plate. Instead of recesses, which are defined outwardly, the recesses may be open along the edge of the plate. The remaining part of the two segments D having a recess of 45° constitutes a tongue, which can cover or uncover an opening A_1, A_2, A_3, in the first plate.

The plates are adapted to be turned about a shared axis in skips of 45°, and at three permanent openings and three tongues, which are arranged as illustrated in Fig. 1, a total of eight turning positions can be selected by turning the first plate eight times each 45° in relation to the second plate, and it will be understood from Fig. 1 that in a first turning position all of the openings A_1, A_2, A_3 of the first plate may be covered by a tongue of the second plate, and that by appropriate turning positions of the plates, combinations of covered and/or uncovered openings can be obtained, whereby at each turning position with openings total restriction areas being mutually different, can be obtained.

This is illustrated in Fig. 2, wherein all three openings A_1, A_2, A_3 at turn position 1 are covered by a tongue, which as indicated by a zero in the columns for the three openings and by a zero in the result column. In turning position 2 the opening A_1 is uncovered as indicated by the figure 1 in the A_1-column and the indication A1 in the result column. At turn positions 3 and 4 it is similarly obtained that the openings A_2 respectively A_3 are open, as indicated by the figure 1 in the A_2- or the A_3-column and A2, respectively A3 in the result column. At turning position 5 the opening A_1 as well as the opening A_2 are

open, and finally all three openings A_1, A_2, A_3 are open at turning position 8.

It should be noted that the turning positions 1 to 8 illustrated in Fig. 2 are not obtained in the order indicated when the first plate is turned in the afore mentioned skips of 45° and in a certain direction of turning. The turning positions are so arranged in the drawing that the result column will appear orderly.

In the arrangement of the openings A_1, A_2, A_3 and the recesses/tongues there will always be at least part of the segment D between these two types of holes.

Fig. 1 illustrates plates, wherein the number of openings is three, wherein the number of segments is four, and wherein there are at least eight turning positions, each differing 45° from one another. It is also possible to design plates having four openings, the number of segments then being eight, and the number of turning positions then totalling sixteen and differing 22,5° from one another.

In each case, the number of openings is determined according to the formula:

$$2^n = Dx2,$$

where D is the number of equally large segments along the circumference, and where there are two turning positions for each segment.

The size of the openings may advantageously be so adapted that the smallest opening determines the size of the remaining openings according to a binary series having the formula:

$$A_p = 2A_{(p-1)}.$$

where p is the number of the hole in the series, and A is the area of the smallest opening.

If the plates are used as a valve for the control of a liquid flow, wherein the smallest opening is adapted to a area which may result in a flow of 10 liters/hour, such an adaptation of the mutual sizes of the openings may result in that the flow at the remaining turning positions may be reduced in skips of 10 liter/hour, starting at 0 liter/hour and up to 70 liter/hour.

Fig. 3 illustrates a valve, which is adapted to be built into the the piping of a heating or cooling system as a unit. The valve housing 1 has an inlet with a cylindrical cavity 16, which is connected to an outlet 10 via a channel, and a first embodiment of an insert 30 is placed in the channel.

The liquid medium is led to the valve housing 1 and into the cylindrical cavity 16, where the medium gets into contact with the lower part of the collected insert 30, comprising a cylindrical inside sleeve or piston 2 having circular section and an outside tubular sleeve 3.

The piston 2 is cup-shaped with its bottom facing the cavity 16, and the piston 2 rests firmly with its circumference against the inside of the sleeve 3 with its circumference and can be moved axially within the sleeve. At the end of the sleeve 3 which is offset from the bottom of the piston 2 the sleeve is connected to a cup-shaped cap 7, the bottom of which is offset from the bottom of the piston 2. The piston 2, the sleeve 3 and the cap 7 enclose coaxially a spring 13 which, resting on the bottoms, will push them in opposite directions. The central part of the

bottom of the piston 2 is designed with an impression, whereas a corresponding thickening is located centrally on the inside of the cap 7, said impression and said thickening serving the purpose of controlling the spring 13 inside the insert.

The piston 2 is at the edge of the bottom provided with three permanent openings 14, each extending 45° along the circumference and offset 90° in relation to one another. The permanent openings 14 have different opening areas A_1, A_2, A_3, the axial lengths of the openings 14 being different.

Furthermore, the edge of the cup-shaped piston 2 is provided with four radially protruding projections, which are spaced at equal distance along the edge.

The edge of the sleeve 3 is on a level with the bottom of the piston 2 designed with axial recesses to the effect that three tongues are created, two of which extend 45° along the circumference, while the third tongue 15 extends at 90°.

At the opposite end of the sleeve 3 and at an equal angular distance of 45° are provided eight axial grooves 6, which can accomodate the four projections 4 of the piston 2 in such a manner that the piston 2 can be pushed axially into the sleeve 3, turned along its axis in a particular turning position out of eight turning positions possible, however, is prevented from turning in relation thereto when the projections 4 are engaged with four of the axial grooves 6. In order to turn the piston 2 in relation to the sleeve 3 into a new turning position, it is therefore necessary to move the piston 2 axially out of the sleeve 3, to the effect that the projections 4 are disengaged from the axial grooves 6. The piston 2 can then be turned into a new

turning position, and the four projections 4 can again be pushed into four other grooves 6 in the sleeve 3.

After the piston 2 has been positioned inside the sleeve 3 in a predetermined turning position, the cup-shaped cap 7 is mounted on the sleeve by means of a connection, which is not illustrated in detail, to the effect that the entire insert 30 comprises the piston 2, the sleeve 3, the cap 7, and the spring 13. The sleeve 3 has on its outer side a tube packing 12, which serves to seal against the inside of the valve housing 1. The mentioned connection between the sleeve 3 and the cap 7 may, for example, consist of an internal circumferential recess along the edge of the sleeve 3, which recess can engage in a circumferential exterior rim of the cap 7, and the two parts are connected by pushing the two parts together under elastic yielding on the part of the edge of the sleeve 3 and/or the cap 7.

The grooves 6 together with the edge of the piston 2 will create a number of variable openings as a result of the axial movement of the piston 2 in the sleeve 3, and these openings are connected to a ring-shaped volume 5 enclosing the insert 30 and being connected to the outlet 10.

In the arrangement described comprising the tongues 15 of the sleeve 3 and the permanent openings 14 at the bottom of the piston 2 described, a total of eight permanent turning positions can be created, in which the tongues 15 can cover the openings 14 individually or in combinations. These combinations may thus include that all permanent openings 14 are covered by tongues 15, that one single opening out of the three permanent openings is covered by a tongue, that two selected openings of the permanent openings are covered by tongues, or that none of the three permanent openings 14 are covered by tongues 15.

This arrangement thus corresponds to the arrangement in the rotary valve described and illustrated in Fig. 1.

If only a single of the permanent openings 14 is not covered by the tongues 15, there will be a difference in pressure between the cavity 16 and the interior cavity of the insert. This difference in pressure will effect the bottom of the piston 2 with an axial thrust which is proportional to the cylindrical area and to the size of the difference in pressure, to the effect that the piston 2 is pushed into the sleeve 3 and will compress the spring 13. The spring 13 will react with a force of equal size and thus create a balance of power on the piston 2. In this position of the piston 2 there will now be a difference in presure betweeen the cavity 16 and the inside cavity of the collected insert 30.

As a result of the axial movement of the piston 2 the top edge will screen a larger or smaller portion of the grooves 6 in the fixed sleeve 3. The size or the area of the grooves 6 thus depend on the axial position of the piston 2 prevailing as a result of the balance of power.

When the medium passes through the grooves 6 there will also be a difference in pressure between the inside cavity of the collected insert 30 and the ring-shaped volume 5 and the outlet 10. This difference in pressure will depend on the size or the area of the grooves 6 and the flow of medium through the collected piping within the system.

The two differences of pressure, which are created by the passage of the medium through one permanent opening or the permanent openings 14 and the grooves 6, will together provide the total difference in pressure over the entire valve. The total difference in pressure will distribute itself so that over one permanent opening, respectively the

permanent openings 14 there will be an approximately constant difference in pressure, which is independent from the total difference in pressure. The degree of the approximately constant difference in pressure depends on construction related conditions only between the forces and modifications of forces on the spring 13 and on the area of the circular bottom of the piston 2.

With the above mentioned approximately constant difference in pressure created over one permanent opening respectively the permanent openings 14, the flow through the system will remain constant, independent from the total difference in pressure.

The axial length of the grooves 6 is adapted to the axial movement of the piston 2 possible to create, as a result of the difference in pressure over one opening or the permanent openings 14 to the effect that the projections at the edge of the piston 2 cannot be disengaged from the grooves 6, whereby an unintended turn of the piston 2 in relation to the sleeve 3 is prevented, while the valve is in operation.

If it is desired to change the permanent position of the opening or the openings 14, without dismantling the valve, it is possible to secure a pin on the inside of the bottom of the piston 2 so that after the pin has been put out through a stuffing box of the cup-shaped cap 7, the piston can be pulled so far towards the cap 7 that the projections 4 of the piston 2 can be disengaged from the grooves 6, and the piston 2 can then be turned into a new turning position.

Fig. 10 illustrates an insert 40 according to a second embodiment of the invention. This insert 40 also has a first restriction area, in which a permanent open position can be

preadjusted, and the second restriction area is a membrane, which is movable in dependence on the difference in pressure in a system having a liquid medium.

This insert 40 likewise comprises a cup-shaped piston 2, which is inserted into a tube shaped sleeve 3 and has its circumference disposed in close contact with the inside hereof. One end of the sleeve 3 is partly closed by means of a wall 19, which has a circular opening 20. The edge of the wall 19 is at the opening 20 provided with at least two projections 21a extending a small distance into the sleeve 3. The opposite open end of the sleeve 3 is provided with a number of hooks 22, which are adapted for engagement by elastic yielding with a circumferential rim 23 of a screw plug 8, whereby the collected insert 40 can be mounted in the valve housing 1.

The bottom of the piston 2 is designed with eight recesses 21b, which accomodate the above mentioned projections 21a of the sleeve 3, and it will be understood that the piston 2 can thus be fixed in a total of eigth turning positions in the sleeve 3 by the engagement between the projections 21a and the recesses 21b, the engagement being secured by means of a spring 13.

The bottom of the piston 2 has on its inside a central, short tube-shaped extension 24, which serves the purpose of controlling the spring 13 inside the piston 2. Towards the outside of the piston 2 the tube-shaped extension 24 is designed with surfaces of engagement 25 for a tool, whereby the piston 2 can be turned inside the sleeve 3, the tool being for example a hexagon Allen key. The edge of the tube-shaped extension 24 projecting through the sleeve 3 has a recess 26, which in its position opposite a series of numbers 27 along an arc arranged on the sleeve 3 indicates a turning position for the piston 2 in relation to the

sleeve 3 og thus a permanent preadjusted position of one permanent opening respectively the permanent openings 14.

In Fig. 11 the recess 26 is located opposite the number 2 of the series of numbers 27 thus indicating that the insert 40 is preadjusted to the turning position 2. It should be noted that the series of numbers 27 does not extend in numerical order in a given direction of turning.

The piston 2 is at the edge of the bottom provided with three openings 14 each extending over 45° along the circumference and being offset 90° in relation to each other. The openings 14 have different areas of opening A_1, A_2, A_3, the axial lengths of the openings 14 being different. The openings 14 may also be created by bores having different sections.

The sleeve 3 is opposite the openings 14 at the bottom of the piston 2 designed with two axial recesses or openings 15, each extending 45° along the circumference, and extending over 90° together with the wall succeeding in the circumferential direction, while the third recess or opening 15 extends over 90°, and the remaining wall likewise extending over 90° in the circumferential direction.

In the arrangement described for the openings 14, 15 at the bottom of the piston 2 respectively the sleeve 3, a total of eight permanent turning positions can be provided, in which the openings 15 can cover the openings 14 individually or in combinations. These combinations can thus comprise the options that all of the openings 14 are covered by the openings 15, that one of the three openings 14 is covered by an intermediate wall of the sleeve 3, that two selected openings 14 are covered by intermediate walls of the sleeve 3 or that none of the three openings are

covered by intermediate walls.

This arrangement thus corresponds to the arrangement in the rotary valve described and illustrated in Fig. 3.

At the open end of the sleeve 3 which carries the hooks 22, a number of longitudinal grooves 6 are provided, which are connected to a ring-shaped space 5 in the valve housing 1, when the insert 40 is mounted therein.

The extension 24 inside the piston 2 accomodates a central pipe 18 extending approximately to the inside of the screw plug 8, where the pipe 18 is controlled by a number of projections 28. It will be seen from Fig. 10 that there is passage through the bottom of the piston 2, the pipe 18 and out between the projections 28 to the space around the projections. Opposite the projections 6 the pipe 18 carries a cup-shaped cap 7, which is slidingly movable along the pipe 18 in tight relationship. The opening of the cap 7 faces the piston 2.

The cap 7 carries a membrane or a bellows 17 of elastic material. The membrane 17 can be described as a short tube, one end of which is rolled over the other end at radial distance, whereupon the radially outermost part is kept tightly fixed between the edge of the sleeve 3 and the screw plug 8, when the hooks 22 engage in the circumferential rim 23 of the screw plug 8. The radially innermost part of the membrane 17 is secured tightly to the cap 7. The membrane 17 will roll over or roll about itself to a smaller or larger extent when moving the cap 7 along the pipe 18, whereby the radially outermost part can increase or decrease and roll over the grooves 6 of the sleeve 3.

The piston 2, the sleeve 3 and the cap 7 enclose the spring 13 coaxially, the spring being controlled by the

pipe 18, and by its abuttment against the bottom of the sleeve 3 and the bottom of the cap 7 will push them in opposite directions. The spring 13 is also controlled by the extension 24 of the bottom of the piston 2, and a corresponding thickness is provided centrally on the inside of the bottom of the cap 7.

After the piston 2 has been positioned inside the sleeve 3 in a predetermined turning position, the cup-shaped cap 7 is mounted on the pipe 18 under compression of the spring 13, and the radially outermost part of the membrane 17 will be clamped to the edge of the sleeve 3 as a result of the engagement of the hooks 22 on the rim 23 so that the collected insert 40 comprises the piston 2, the sleeve 3, the cap 7, the membrane 17 and the spring 13. The washer 3 has on its outer side a tube packing 12 for sealing against the inner side of the valve housing 1 after the insert 40 has been mounted therein.

If only one single of the openings 14 between the piston 2 is not covered by the intermediate walls between the openings 15 of the sleeve 3, there will be a difference in pressure between the cavity 16 and the inside cavity of the insert 40. This difference in pressure can effect the membrane 17 with an axial thrust, which is proportional to the cylindrical area and the size of the difference in pressure, whereby the membrane 17 can be rolled into the sleeve 3 and compress the spring 13 together. The medium can also from the cavity 16 flow through the central pipe 18 and effect the membrane 17. The spring 13 will react with a force of equal size and thus create a balance of power on the membrane 17. In this position of the membrane 17 there will now be a difference in pressure between the cavity 16 and the inside cavity of the collected insert 40.

As a result of the axial rolling, the membrane 17 will

screen a larger og smaller part of the grooves 6 of the fixed sleeve 3. The sizes of the grooves 6 thus depend on the axial position of the membrane 17 prevailing as a result of the balance of power.

When the medium passes through the grooves 6 there will likewise be a difference in pressure between the inside cavity of the collected insert 40 and the ringshaped volume 5 and the outlet 10. This difference in pressure is dependent on the sizes of the grooves 6 and the flow through the collected piping of the system.

The two differences in pressure, which are created by the passage of the medium through one permantly adjusted opening or the permanently adjusted openings 14 and the variable openings in the form of the grooves 6, will together create the total difference in pressure over the entire valve. The total difference in pressure will distribute itself so that over one permanent opening respectively the permanent openings 14 there will be an approximately constant difference in pressure, which is independent of the total difference in pressure. The degree of the approximate difference in pressure is dependent only on forces and modifications of forces on the spring 13 as well as on the size of the circular area of the membrane 17.

As a result of the above described approximately constant difference in pressure over one permanent opening respectively the permanent openings 14, the flow through the system will remain constant, independent of the total difference in pressure.

The axial lengths of the grooves 6 are adapted in proportion to the axial rolling possible of the membrane 17, which can be produced by the difference of pressure over one permanent opening or the permanent openings 14.

C L A I M S

1. A throttle valve, especially for the control of liquid flow in a central heating or airconditioning system consisting of two concentric elements, for example two circular plates disposed in close contact with each other, or two cylindrical sleeves, one of which is inside the other, said elements having a number n of holes and being adapted to turn individually to create a restriction area with a permanent open position, which is optional among several open positions having different areas (A_1, A_2,.., A_n), and being located equidistantly along the circumference of the elements, the number n of holes in one element being equal to the number of covering areas in the second element, characterized in
that both elements are divided into segments of equal size,
that each segment has a maximum of one hole,
that the area of the holes in one element is larger than the area (A_n) of the largest hole in the second element, and
that the equidistant division is determined by the number n of holes according to the formula:

$$2^n = Dx2,$$

wherein D is the number of equally large segments along the circumference, and where there are two turning positions for each segment D.

2. Valve according to claim 1, characterized in that there is at all times at least part of one segment between two holes.

3. Valve according to claim 1 or 2, characterized in that the smallest hole determines the size of the remaining holes according to a binary series having the formula:

$$A_p = 2A_{(p-1)}.$$

where p is the number of the hole in the series, and A is the area of the smallest hole.

4. Valve according to claims 1 - 3, wherein the elements consist of a piston (2) and a sleeve (3), which encloses the piston (2) concentrically and together herewith constitutes a first restriction area (14, 15) having a selective permanent opening area (A_1, A_2, ,,, or A_n), <u>**characterized in**</u> that the first restriction area (14, 15) is positioned in series with a second restriction area (2, 3) comprising one or more openings (6), which are variable by screening of the piston (2) being movable in the axial direction of the sleeve (3), the degree of screening being determined by the total difference in pressure over the valve in proportion to the difference in pressure over the first restriction area (14, 15).

5. Valve according to claim 4, <u>**characterized in**</u> that the first restriction area comprises three openings (14) provided in the bottom of the cup-shaped piston (2), each having their own area (A_1, A_2, A_3), which can be covered individually or in combination as desired by three tongues (15) on the sleeve (3), and in that the second restriction area (2, 3) is constituted by the edge of the piston (2) in conjunction with axial grooves (6) in the sleeve (3).

6. Valve according to claims 1 - 3, wherein the elements consist of a piston (2) and a sleeve (3), which encloses the piston (2) concentrically and together herewith constitutes a first restriction area (14,15) having a selective permanent opening area (A_1, A_2, ,,, or A_n), <u>**characterized in**</u> that the first restriction area (14, 15) is positioned in series with a second restriction area (3)

having a membrane (17) comprising one or more openings (6) which can be varied by screening of the membrane (17), being movable in the axial direction of the sleeve (3), the degree of screening being determined by the total difference in pressure over the valve in proportion to the difference in pressure over the first restriction area (14, 15).

7. Valve according to claim 6, <u>characterized in</u> that the first restriction area comprises three openings (14) provided in the bottom of the cup-shaped piston (2) each having their own area (A_1, A_2, A_3), which can be covered individually or in combination as desired by three wall parts (15) of the sleeve (3), and in that the second restriction area (3, 17) is constituted by the membrane (2) by rolling of the membrane (17) over the axial grooves (6) in the sleeve (3).

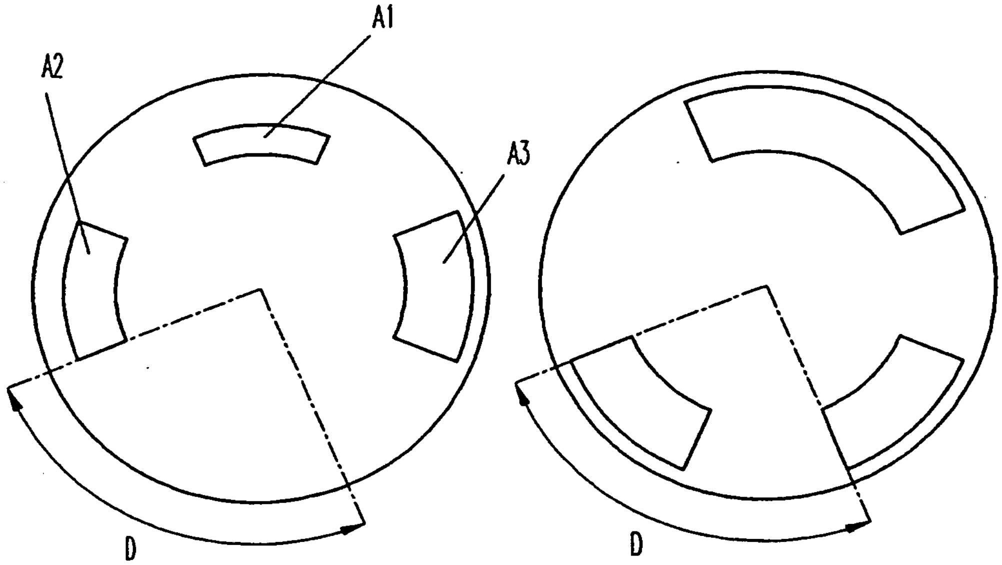

Fig. 1

Drejestilling	Restriktions areal A1	A2	A3	Resultat
1	0	0	0	0
2	1	0	0	A1
3	0	1	0	A2
4	0	0	1	A3
5	1	1	0	A1 + A2
6	1	0	1	A1 + A3
7	0	1	1	A2 + A3
8	1	1	1	A1 + A2 + A3

Fig. 2

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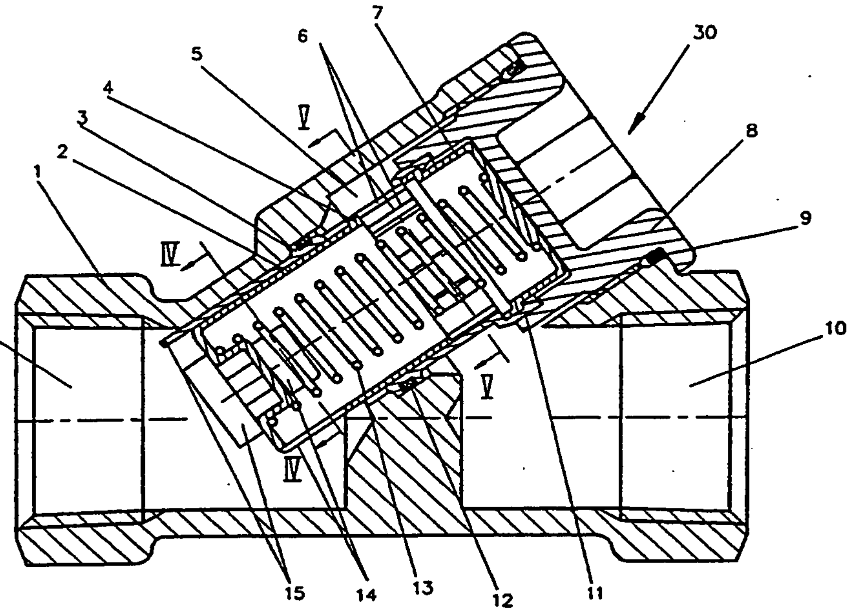

Fig. 3

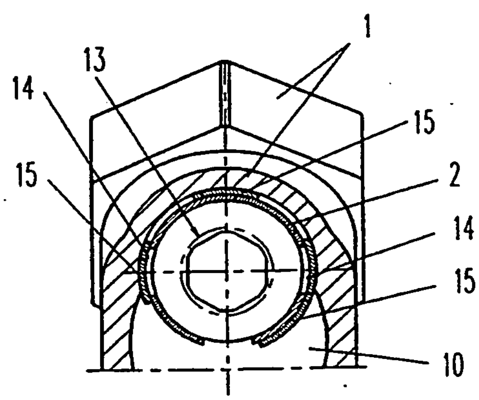

Fig. 4

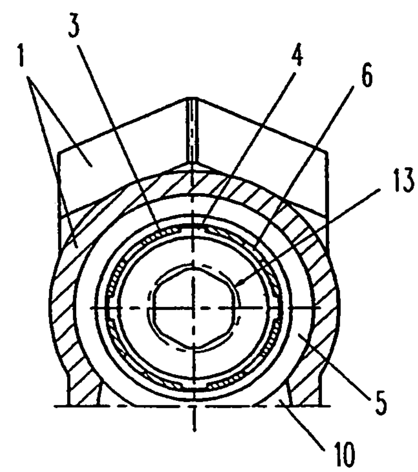

Fig. 5

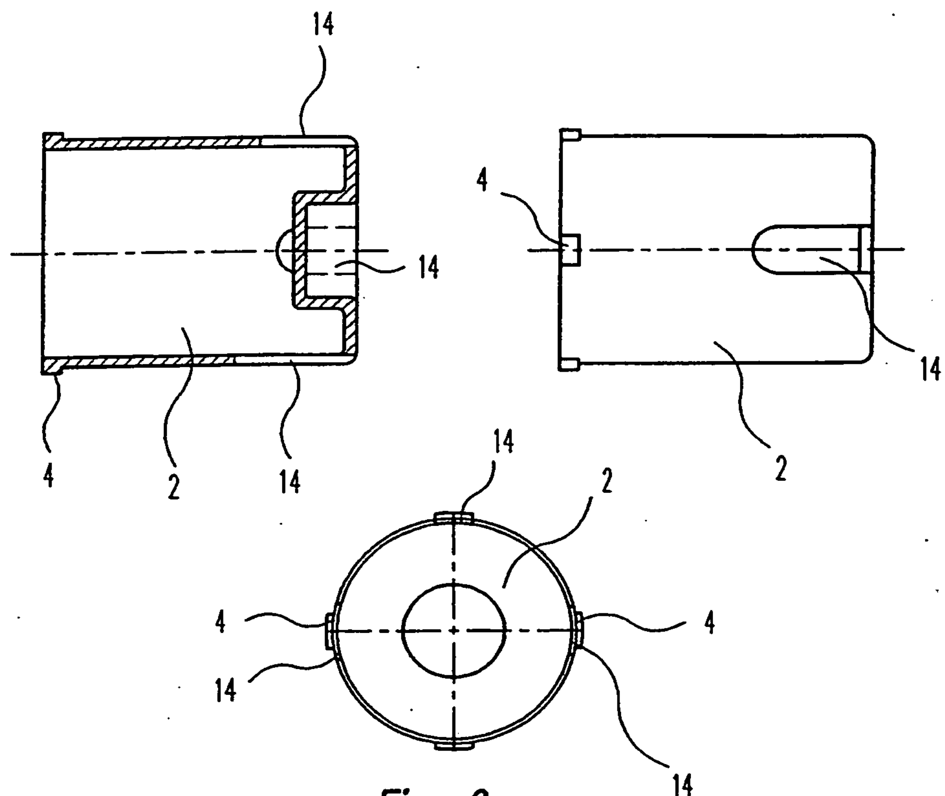

Fig. 6

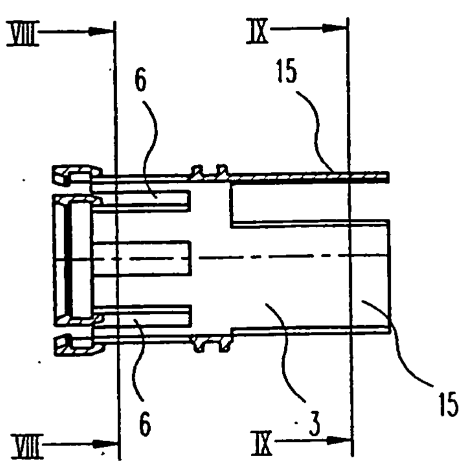

Fig. 7

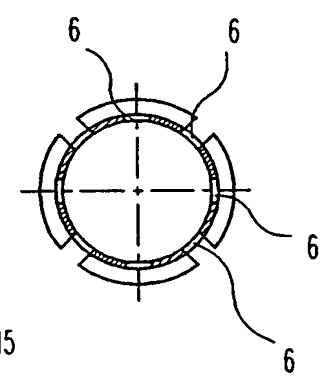

Fig. 8

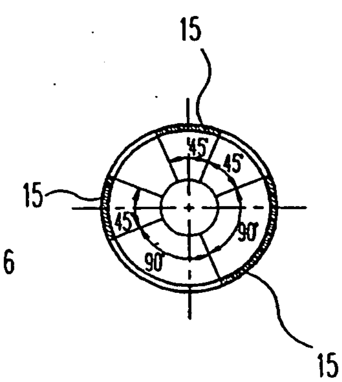

Fig. 9

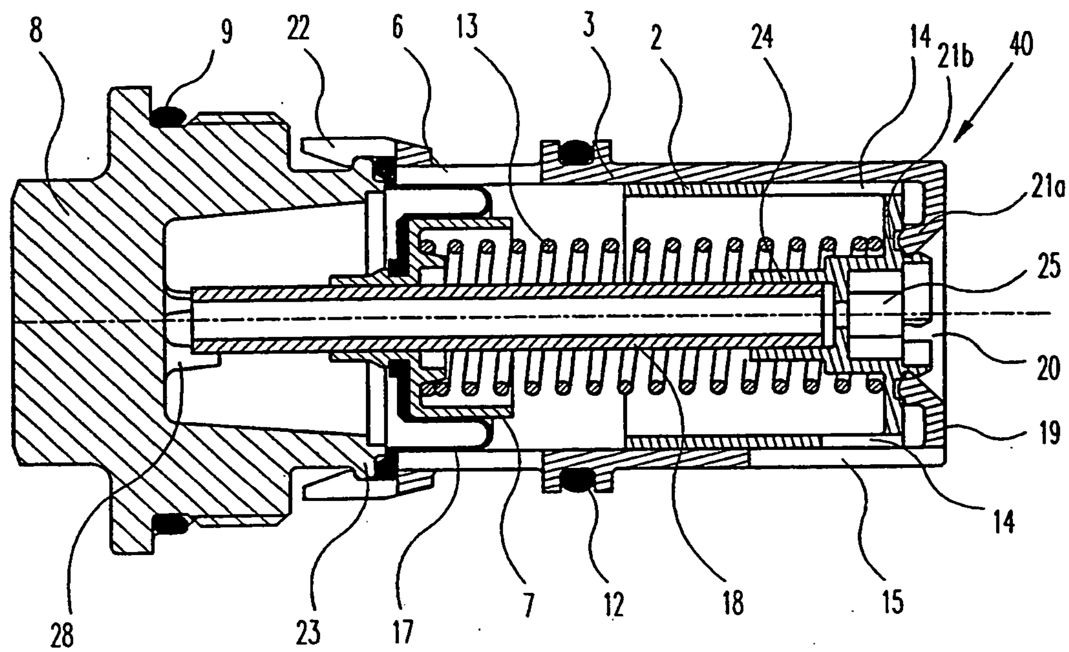

Fig. 10

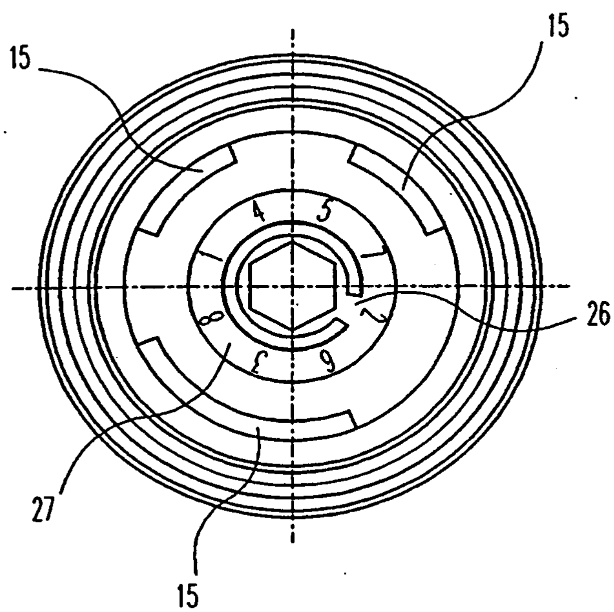

Fig. 11

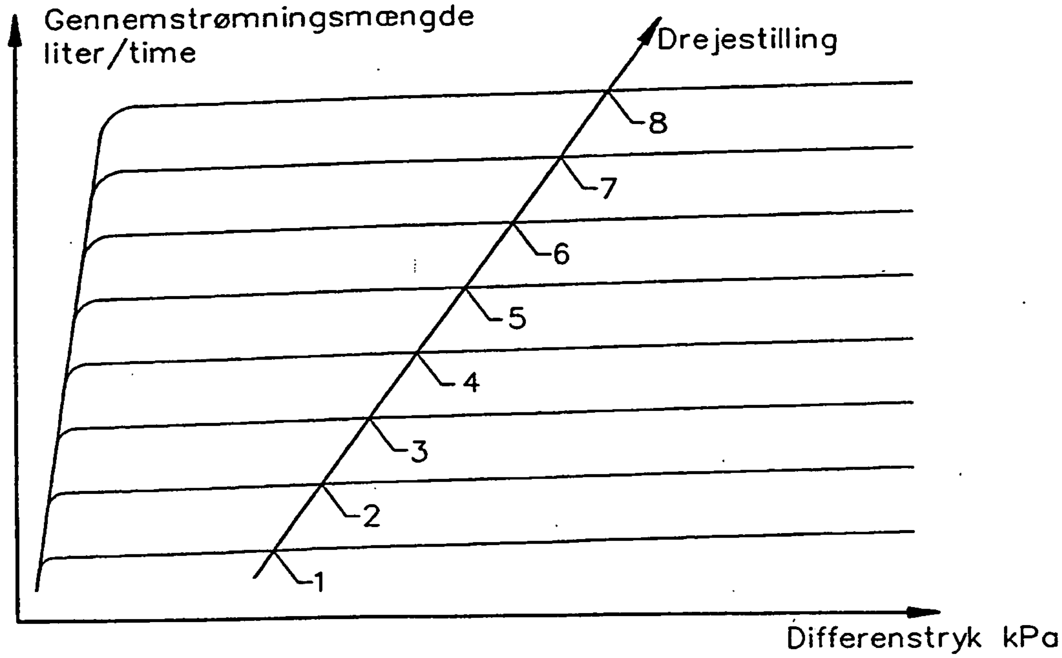
Gennemstrømningsmængde
liter/time
Drejestilling
8
7
6
5
4
3
2
1
Differenstryk kPa

Fig. 12

INTERNATIONAL SEARCH REPORT

International application No.
PCT/DK 94/00391

A. CLASSIFICATION OF SUBJECT MATTER

IPC6: F16K 3/26

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

IPC6: F16K

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

SE,DK,FI,NO classes as above

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	Patent Abstracts of Japan, Vol 9,No 94, M-374, abstract of JP, A, 59-219579 (OOKAWARA SEISAKUJIYO K.K.), 10 December 1984 (10.12.84) --	1
A	US, A, 4527595 (JORGENSEN ET AL), 9 July 1985 (09.07.85), figures 1-8 --	1
A	DE, B1, 2555752 (GESTRA-KSB-VERTRIEBSGESELLSCHAFT MBH & CO KG), 14 April 1977 (14.04.77), figures 1-4 --	1

☐ Further documents are listed in the continuation of Box C.

☒ See patent family annex.

* Special categories of cited documents:

"A" document defining the general state of the art which is not considered to be of particular relevance

"E" erlier document but published on or after the international filing date

"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)

"O" document referring to an oral disclosure, use, exhibition or other means

"P" document published prior to the international filing date but later than the priority date claimed

"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention

"X" document of particular relevance: the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone

"Y" document of particular relevance: the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art

"&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
1 February 1995	06 -02- 1995
Name and mailing address of the ISA/ Swedish Patent Office Box 5055, S-102 42 STOCKHOLM Facsimile No. +46 8 666 02 86	Authorized officer Christian Westberg Telephone No. +46 8 782 25 00

INTERNATIONAL SEARCH REPORT
Information on patent family members

31/12/94

International application No.
PCT/DK 94/00391

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
US-A- 4527595	09/07/85	DE-A,C- 3223206	22/12/83
		FR-A- 2528995	23/12/83
		GB-A,B- 2122316	11/01/84
		SE-B,C- 453616	15/02/88
		SE-A- 8303238	23/12/83
DE-B1- 2555752	14/04/77	CA-A- 1045938	09/01/79
		CH-A- 597541	14/04/78
		FR-A,B- 2334900	08/07/77
		GB-A- 1540302	07/02/79
		US-A- 4109683	29/08/78

CORRECTED VERSION*

PCT

WORLD INTELLECTUAL PROPERTY ORGANIZATION
International Bureau

INTERNATIONAL APPLICATION PUBLISHED UNDER THE PATENT COOPERATION TREATY (PCT)

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(71) Applicant (*for all designated States except US*): FLOWCON INTERNATIONAL I/S [DK/DK]; Sorøvej 6, DK-4200 Slagelse (DK).

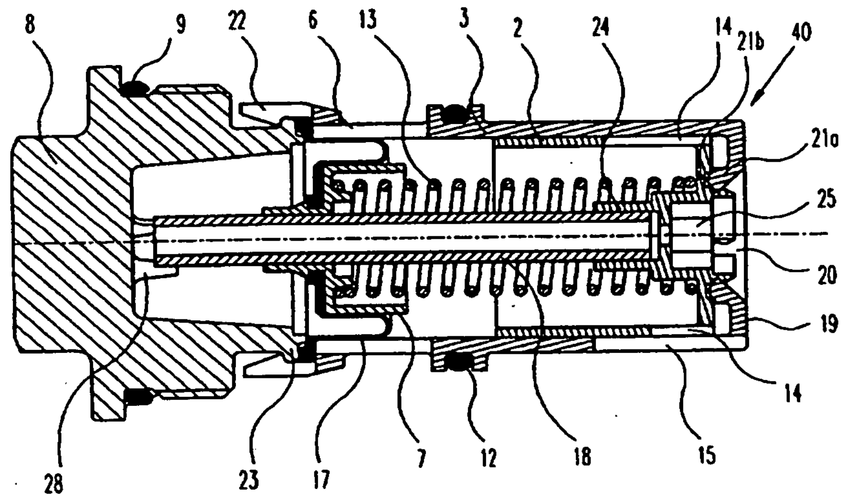
(71)(72) Applicant and Inventor: MOESBY, Peter [DK/DK]; FlowCon International I/S, Sorøvej 6, DK-4200 Slagelse (DK).

(74) Agent: LARSEN & BIRKEHOLM A/S; Skandinavisk Patentbureau, Skagensgade 64, DK-2630 Taastrup (DK).

(81) Designated States: AM, AT, AU, BB, BG, BR, BY, CA, CH, CN, CZ, DE, DK, EE, ES, FI, GB, GE, HU, JP, KE, KG, KP, KR, KZ, LK, LR, LT, LU, LV, MD, MG, MN, MW, NL, NO, NZ, PL, PT, RO, RU, SD, SE, SI, SK, TJ, TT, UA, US, UZ, VN, European patent (AT, BE, CH, DE, DK, ES, FR, GB, GR, IE, IT, LU, MC, NL, PT, SE), OAPI patent (BF, BJ, CF, CG, CI, CM, GA, GN, ML, MR, NE, SN, TD, TG), ARIPO patent (KE, MW, SD, SZ).

Published
With international search report.
In English translation (filed in Danish).

(54) Title: STOP OR SLIDE VALVE, ESPECIALLY FOR THE CONTROL OF LIQUID FLOW IN A CENTRAL HEATING OR AIR CONDITIONING PLANT



(57) Abstract

a throttle valve comprises a piston element (2) and a sleeve (3), which encloses and can be turned around the piston element (2). Each element (2, 3) is provided with a number n of holes and is adapted to be turned individually to create the restriction area (14, 15), the number n of holes (14) in one element (2) being equal to the number of covering areas (15) in the second element (3). The valve can be used for automatic regulation of a central heating or air-conditioning system so that the flow is limited to a predetermined amount in the entire system, in one part hereof or in several parts hereof being divided into zones, when both elements (2, 3) are divided in equally large segments, when there is a maximum of one hole in each segment, when the area of the holes in one element (2) is larger than the area (A_n) of the largest hole in the second element, and when the equidistant division is determined by the number n of holes according to the formula $2^n = Dx2$, where D is the number of equally large segments along the circumference and where there are two turning positions for each segment D.

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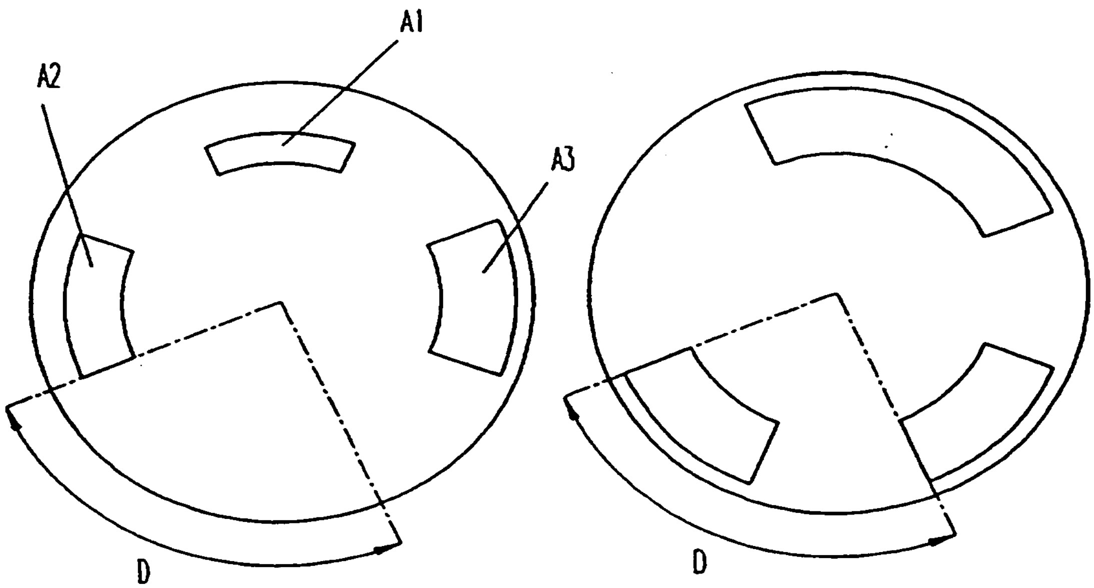

Fig. 1

Turning position	Restriction area A1	A2	A3	Result
1	0	0	0	0
2	1	0	0	A1
3	0	1	0	A2
4	0	0	1	A3
5	1	1	0	A1 + A2
6	1	0	1	A1 + A3
7	0	1	1	A2 + A3
8	1	1	1	A1 + A2 + A3

Fig. 2

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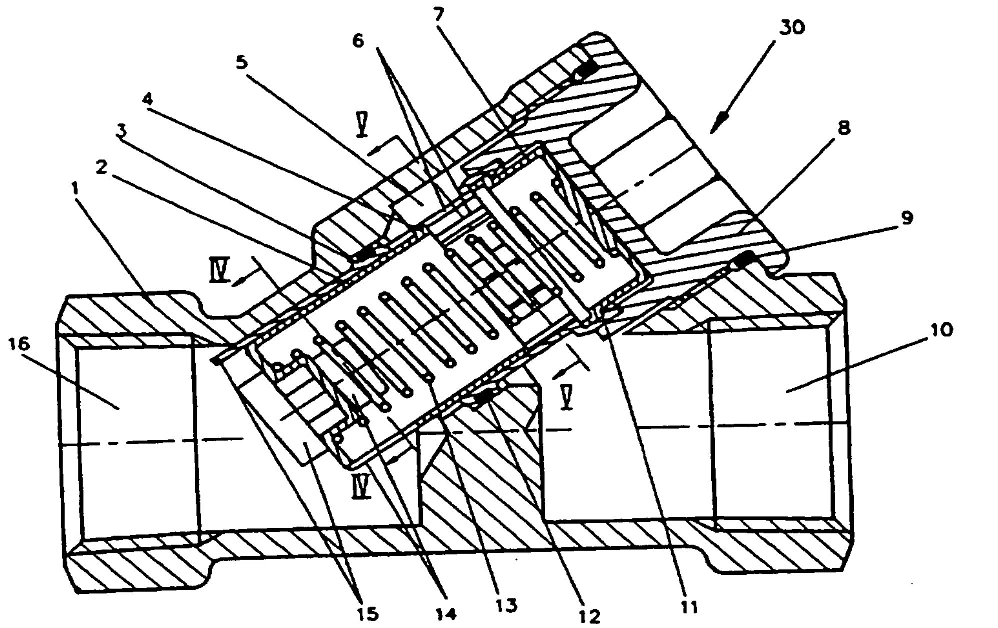

Fig. 3

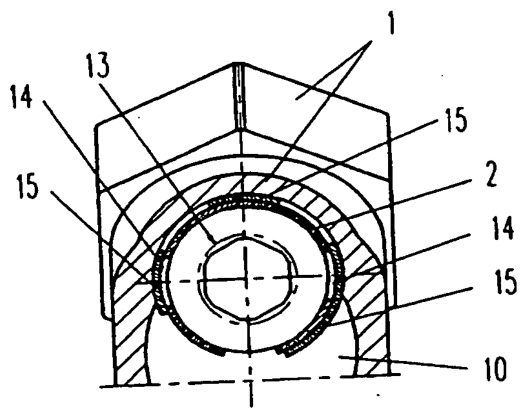

Fig. 4

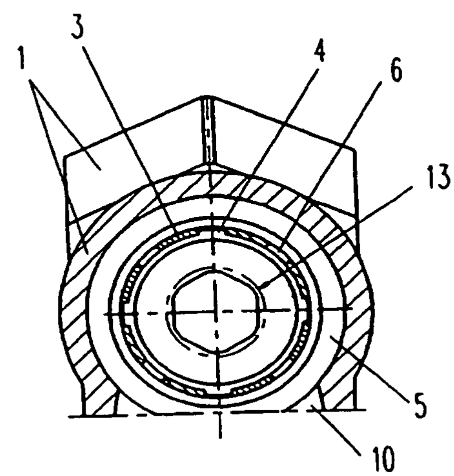

Fig. 5

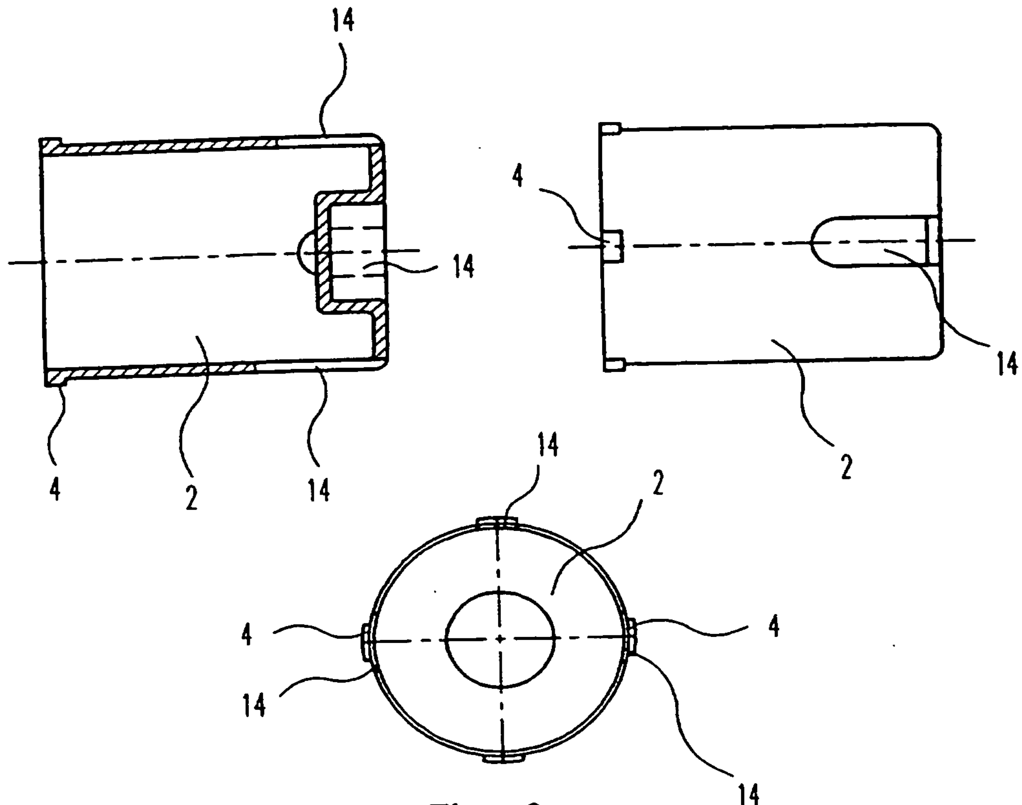

Fig. 6

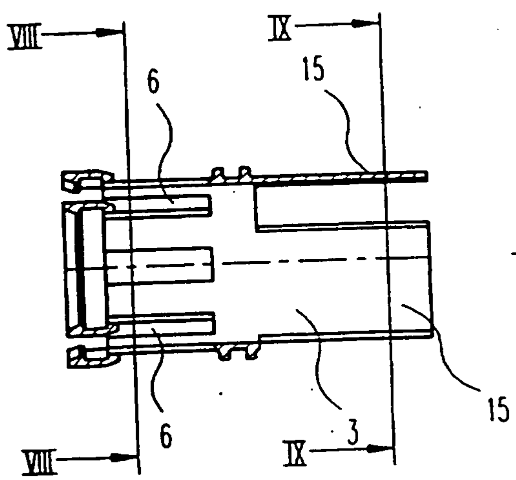

Fig. 7

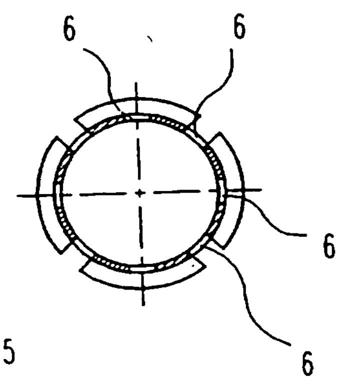

Fig. 8

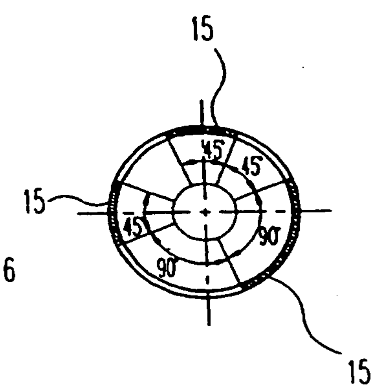

Fig. 9

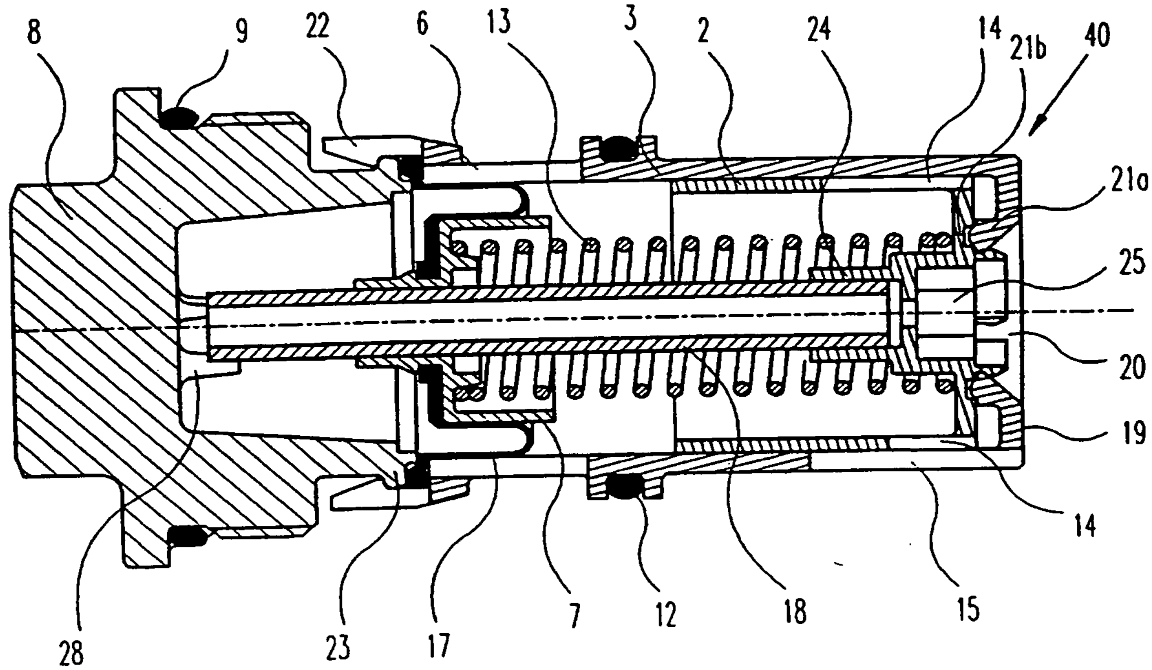

Fig. 10

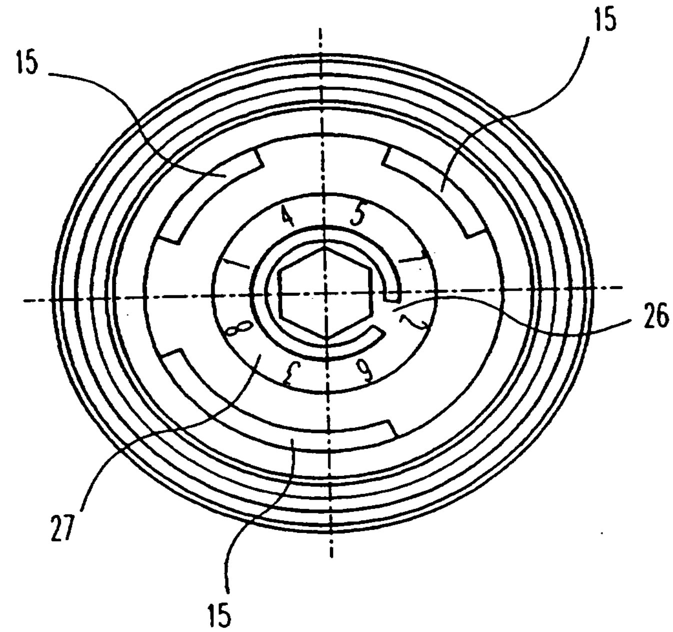

Fig. 11

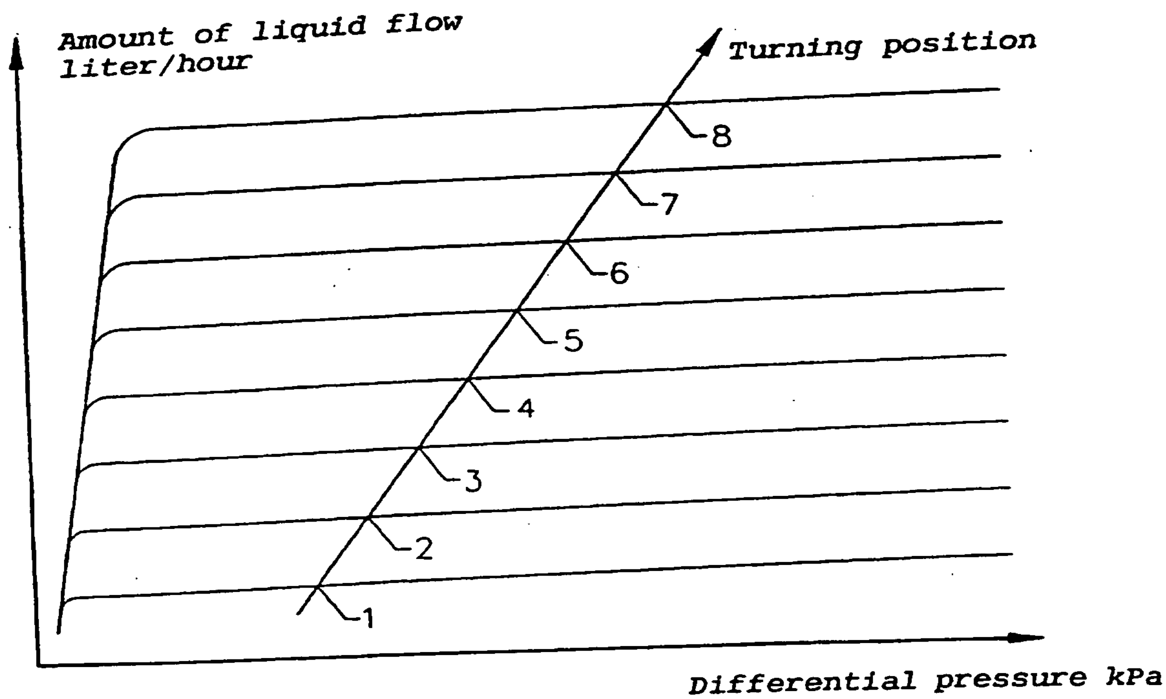
Amount of liquid flow
liter/hour
Turning position
8
7
6
5
4
3
2
1
Differential pressure kPa

Fig. 12